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ABSTRACT

The effects of a procedure based on differential reinforcement of other behaviors (DRO) on stereotypic responses and task performance were tested with three autistic students (14-21 years old). The procedure was unique because the time interval employed between potential opportunities for reinforcement was the natural length of one instructional trial delivered to a peer. Thus, the procedure was designed to reduce the level of stereotypic respones during small group instruction. The results indicated that the procedure exerted functional control over the students' stereotypic responses. In addition, two of the students had significantly greater percentages of correct responses under DRO conditions. The results are discussed in terms of models for intervention within task contexts and the usefulness of the procedure under natural teaching conditions. (Author)

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The Use of Differential Reinforcement of Other Behaviors to Reduce Stereotyped Behavior of Autistic Students During Group Instruction.

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Abstract

The effects of a procedure based on differential reinforcement of other behaviors (DRO) on stereotypic responses and task performance was tested with three autistic students. The procedure was unique because the time interval employed between potential opportunities for reinforcement was the natural length of one instructional trial delivered to a peer. Thus, the procedure was designed to reduce the level of stereotypic responses during small group instruction. The results indicated that the procedure exerted functional control over the students stereotypic responses. In addition, two of the students had significantly greater percentages of correct responses under DRO conditions. The results are discussed in terms of models for intervention within task contexts and the usefulness of the procedure under natural teaching conditions.

The Use of Differential Reinforcement of Other Behaviors to Reduce Stereotyped Behavior of Autistic Students During Group Instruction

The differential reinforcement of other behaviors (DRO) has been advocated as a non-aversive alternative for controlling stereotypic behaviors of autistic students (La Vigna, 1980). Despite a relatively long history of research, there continues to be interest concerning investigations of DRO because there are few other methods based on positive reinforcement that are effective with youth who have severe handicaps. In typical applications of DRO, a reinforcer is delivered after some specified amount of time elapses without the occurrence of a targeted behavior.

While it is preferable to attempt to control aberrant behavior with non-aversive procedures such as DRO (Gaylord-Ross, 1980), problems in using DRO have limited its use by teachers and behavioral specialists (Schrader, Shaul, & Elmore, 1983). Specifically, DRO may be rejected as a possible positive alternative because the procedure is seen as too time consuming to effectively implement, especially when extremely short time intervals are used. Additionally, the research literature concerning applications of DRO has frequently been artificial in nature in that the procedure has been applied while students are not occupied in typical school, home, or vocational activities. Frequently in studies

concerning DRO, one experimenter is available to work with one student for relatively long periods of time.

Within school programs for autistic youth, one teacher frequently teaches several students simultaneously by alternating instructional trials between students. Effective procedures are needed to reduce the stereotypic behaviors of autistic students that can be applied under typical group teaching conditions. The present investigation concerns the application of a DRO procedure that has been adapted for use during group instruction.

While there are few investigations using DRO with autistic students, there is a well established literature with mentally retarded students (Dehaven, Rees-Thomas & Benton, 1980; Harris & Wolchik, 1979; Konczak & Johnson, 1983; Luiselli, Pollow, Colozzi & Teitelbaum, 1981; Luiselli & Slocomb, 1983; Murphy, Nunes & Hutchings-Ruprecht, 1977; Repp, Deitz & Speir, 1974). Unfortunately, most studies included DRO in larger treatment packages (eg. Luiselli & Krause, 1981) rather than investigating its effectiveness as a discrete treatment (e.g. Foxx & Azrin, 1973; Rose, 1979). Consequently, it is still unclear to what extent DRO would be effective when used without the concurrent use of other procedures intended to reduce behavior problems.

Given that instruction within small groups has been found to be organizationally more efficient than one-to-one instruction, (Alberto, Jobes, Sizemore & Doran, 1980; Favell, Favell, & McGimsey, 1978; Rincover & Koegel, 1977; Storm & Willis, 1978), the procedure was designed to reduce the

occurrence of stereotypic behavior while another student received an instructional trial. Because the purpose of the study was to test a DRO procedure during instruction, DRO was used in combination with rewards for correct responses during instructional trials. Thus, a second purpose of the study was to investigate the effects of the simultaneous use of two schedules of reinforcment (DRO for stereotypic behavior and continuous reinforcement for correct responses). The procedure could be defined as a multiple schedule intervention (Ferster and Skinner, 1955) because the students were required to met a pre-set criterion for stereotypic behavior and correct responses on tasks in order to gain access to reinforcement.

Method

Participants

Three autistic youth between the ages of 14 and 21 participated. The participants had been classified as autistic by independent agencies prior to the start of the experiment and conformed to standards for diagnoses of autism and developmental delay with autistic characteristics (Ritvo & Freeman, 1978). Each student was considered to be severely handicapped and required instruction in all major areas of life functioning. They displayed high levels of stereotyped behaviors such as rocking, vocalizations, jumping, and finger flapping. The students were selected for inclusion in the study because behavioral observations indicated that their stereotyped behavior significantly interferred with

responding to instructions.

Susan, who was 17-years-old, was estimated to be functioning at the 6.0-year-old level with the Vineland Social Maturity Scale. She had a small functional vocabulary and would request items, label items, and express basic needs. However, most of her speech consisted of delayed echolalic phrases which would be repetitively produced. Carl, who was 14-years-old, was estimated to be functioning at an age equivalent of 2 years, 11 months with the Vineland Social Maturity Scale. He did not use speech functionally, although he produced vocalizations in a repetitive sing-song fashion. He communicated wants and needs using protest responses, and gestures toward desired items. Donald, who was 21-years-old, was estimated to functioning at approximately a 2.5-year-old level with the Vineland Social Maturity Scale. His speech consisted of single-word labels and simple requests. Using the AAMD Adaptive Behavior Scale (comparing to an institutionalized population), his stereotypic behavior was estimated to be within the 85th percentile. At the time of the study, each student was enrolled in a special education program for autistic and other severely handicapped adolescents. Their school program stressed systematic instructional procedures applied to independent living skills, and social-communicative exchanges with nonhandicapped students.

Setting

All sessions were conducted in the participant's special education classroom. The classroom was 7m by 10m and was

sub-divided into a leisure area, an area simulating a sheltered workshop environment, and an area for small group instruction. Experimental sessions were conducted in the group instruction area. The group instruction area was 2m by 3m and was physically separated from the classroom with the use of two partitions. The area contained a table and three chairs. After each instructional session, the students received free-time in the leisure area. The free-time area was designed to simulate a family room environment. It contained a sofa, a record player, several comfortable chairs, and various free-time activities such as magazines and games.

Teacher and Observers

The same teacher (the second author) conducted all of the sessions with the three students. The teacher had extensive experience in conducting behavioral training with autistic students. The observers were the first author and an advanced graduate student with extensive background in recording responses as they occur in real time. The graduate student was blind as to the experimental hypotheses.

Instructional Tasks

The tasks were those currently being taught in the school program and were included in each participant's individualized instructional program. Alterations in the instructional programs, i.e. addition of new stimuli, were made as students met criterion with specific items. The tasks were taught

using a correction procedure. That is, following the delivery of an instructional cue by the teacher, the students were given 3 sec to independently initiate a response. If a response was not initiated or if the response was incorrect, the student was prompted to produce the correct response. The prompts delivered were initially either verbal prompts or gestures to bring the student's attention to the features of the task that would promote a correct response. Failing those less intrusive responses, the students were be physically guided to produce the correct response.

Susan. A payment strategy was being taught. The teacher prompted Susan to choose a packaged grocery item from several on the table. The teacher then delivered the cue, "That will be (price on package) please." The student responded by counting out dollar bills until she had counted one dollar more than the dollar amount requested by the teacher (e.g. if the teacher requested $2.45, she counted out three dollars).

Carl. Selecting the proper coin combination for riding public transportation was being taught. Two quarters, a nickel and a dime were placed in front of the student. The teacher presented the instruction, "Get your bus money." The student responded by selecting the dime and a quarter.

David. This student was being taught to partially participate in preparing shopping lists for meals. Donald was presented with a 10 X 20 cm picture of a meal. Donald responded by saying the name of at least four foods in the picture.

Experimental Design

An ABAB design was employed for each of the participants. Following exposure to baseline conditions (A), the DRO intervention (B) was introduced. Soon after the DRO procedure produced a noticeable change in the level of stereotypic responding, the procedures were reversed to baseline conditions (A). Following a noticeable increase in stereotypic behavior, the DRO procedure (B) was again introduced. One session was run per school day. Sessions ranged in length from 5 to 25 minutes.

Baseline

The sessions began with the teacher prompting a participant and another autistic student to stop working on an independently performed pre-vocational task and enter the small group instructional area. The same autistic peer received instruction with all three participants. All training was conducted with the teacher, the autistic peer, and one of the participants. Training was conducted in a discrete trial format, with the teacher alternating from student to student.

The classroom that the students attended employed a token economy throughout the school day. During each task, students received tokens on a variety of schedules, including continuous reinforcement and variable interval schedules. During baseline sessions students received one token for each

correct response. Tokens (actual coins) were placed on cards that were located to each student's side. The card was marked with ten circles. When each circle was covered with a coin, the student said "I'm finished", and independently took a five minute break in the classroom's freetime area. Thus, the number of trials during baseline varied from day to day depending on the number of errors that a student made. The number of trials averaged 14, with a range of 10 to 19 per session. One session was conducted per school day.

DRO

The DRO sessions were conducted exactly as the baseline sessions with the following changes. The token card by the student's side was altered such that five of the circles were colored red, while five remained white. Students continued to receive tokens for each correct response during instructional trials. Tokens received for correct answers were placed over the white circles. When the students omitted specific stereotypic responses during the peers trial, they received a token which was placed on a red circle. Immmediately after the peer's trial the teacher determined whether or not an operationally defined stereotypic behavior had occurred during the trial. If a stereotypic response had occurred the teacher ignored it and conducted another trial with the peer. The teacher continued to ignore all stereotypic behavior until one complete instructional trial with the peer had occurred without stereotypic responses from the

participant. Thus, the procedure corresponds to the suggestion made by Bellamy, Horner and Inman (1978) that students not be prompted to come "on task". Instead, the student is rewarded for bringing themselves on task (ie displaying good waiting behaviors). As before, the student was required to fill all circles on the token card prior to receiving a five minute break. During DRO sessions, the teacher delivered tokens for correct responding, and the autistic peer (prompted by the teacher) delivered tokens to the autistic participant for omitting stereotypic responses.

Dependent Variables

Autistic Stereotypic Behaviors. Prior to the start of experimental observations, the authors made extensive nonexperimental observations of the autistic student's behavior during instruction. Based upon these independent observations, a list of behaviors was produced for each participant. Only those responses which would potentially interfere in the instructional process were included on the list of responses for each student. All of the responses that were operationally defined for the experiment were performed repetitively and corresponded to definitions of stereotypic behaviors typically employed with autistic students. The specific stereotypic responses for each student are descibed in Table 1.

Insert Table 1 about here

The teacher recorded the occurrence or nonoccurrence of stereotypic behavior during each instructional trial that the peer received. The dependent variable was the number of trials required to met criterion (5 trials, not necessarily consecutive, delivered to a peer wherein the student did not produce a targeted stereotypic response).

Task Performance. The dependent variable reflecting task performance was the percentage of unprompted correct responses. The teacher (and observers) counted the number of correct unprompted trials and the number of trials that required a prompt.

Reliability of the Dependent Variables

Two independent observers scored 19 (24%) of the sessions. Reliability sessions were conducted at least once during each phase of the study across the participants. The percentage of interobserver agreement was calculated on a point-by-point basis (Kazdin, 1982). The percentage of agreement for the task performance data was 100% on every occasion. The percentage of agreement for the occurrence stereotypic behaviors ranged from 89% to 100% with a mean of 99%.

Results

DRO and Stereotypic Behavior

The results of using the DRO procedure on the stereotypic behavior produced by Susan are represented in Figure 1. The figure shows that the initial baseline data

point was collected over 11 sessions of training. Across those eleven days, she required 158 trials to accummulate 5 intertrial (between Susan's trial and a peer's trial) intervals wherein she did not produce stereotypic behaviors. When the DRO procedure was introduced, the number of trials required to reach the criterion dropped to a mean of 29.8. When the baseline conditions were again introduced, Susan required 54 trials to reach the criterion. The figure indicates that those 54 trials were conducted over 4 days. After the second baseline phase, the DRO procedure was again introduced. As before, the DRO procedure produced a reduction in the number of trials required to reach criterion. During the second DRO condition, Susan required a mean of 22.3 trials to reach criterion.

Insert Figure 1 about here

The results for David are represented in Figure 2. The figure indicates that David averaged 15.5 trials to reach criterion during the first baseline sessions. The initial baseline data were colected over 5 sessions. Upon introduction of the DRO procedure, the mean number of sessions required to reach criterion was reduced to 6.5. When the baseline conditions were introduced the second time, the number of trials required to reach criterion showed an immediate increase from the level observed during the DRO condition. The second baseline (which lasted 5 sessions) produced a mean of 21.5 trials. When the DRO procedure was introduced for the second time, a mean of 8.1 trials was

needed to reach criterion.

Insert Figure 2 about here

The data for Carl are represented in Figure 3. Figure 3 shows that Carl's initial baseline was somewhat unstable. A mean of 10.5 trials was required to reach criterion. Upon introduction of the DRO procedure, Carl's mean number of trials required fell to 6. On the last two days of the first DRO phase, Carl reached criterion within the minimum number of trials possible. When the baseline conditions were reinstated, the number of trials to criterion progressively increased, ultimately producing a mean of 13.7. When the DRO phase was re-instituted, the number of trials to criterion dropped immediately and produced a mean of 5.8.

Insert Figure 3 about here

In summary, across the three participants, the introduction of the DRO procedure consistently produced means that were lower than baseline performance. In addition, the introduction of the DRO procedure produced a rapid reduction in the number of trials required to reach the criterion. Thus, it appears that the DRO procedure as it was applied produced a functionally controlled reduction in the stereotypic responses of the participants.

Task Performance

The data concerning task performance produced less consistent results. The task performance data was tested

using the Irwin-Fisher exact probability test (Marascuilo and McSweeney, 1977). Each student's data were separately analyzed. To perform the test, the baseline data from each participant was combined and tested against the combined data from the two DRO phases. Carl and Susan produced significantly greater percentages of correct responses during DRO conditions (for Carl M = 76.9% and for Susan M = 92.4%) than during baseline condition (for Carl M = 51.5% and for Susan M = 68.3%), For Carl's data, the statistical analysis yielded Z = 12.1, $p < .001$,and for Susan's data; Z = 2.63, $p < .01$. In contrast, the results for the difference in David's task performance between the two conditions was not significant.

Discussion

The results indicated that the DRO procedure functionally reduced the level of stereotypic responding across the three participants. For both Carl and David, the level of reduction achieved was educationally useful, in that by the end of the study they were performing consistently near the criterion level.

The level of behavior change achieved with Susan was somewhat less educationally important, especially during the first introduction of the DRO procedure. Although the degree of reduction achieved with Susan was substantial, she continued to require an average of nearly 30 trials delivered to her peer in order accumulate 5 trials of omitting the targeted stereotypic responses. Thus on a typical day, the

teacher would have to deliver 30 trials to a peer while delivering 5 to Susan. Fortunately, when the DRO procedure was introduced the second time, Susan's mean number of trials dropped somewhat from the initial use of the DRO procedure, and in addition, a negative trend seemed to be established so that by the last two days only 7 and 12 trials were required before Susan accumulated 5 successful trials (however, this still represents omitting stereotypic responses during only 71% and 42% of the peer's trials).

Although the results for Susan's stereotypic responses may arguably be considered to lack a high degree of educational significance (Gaylord-Ross, 1978; Voeltz and Evans 1983), the DRO procedure was associated with improved levels of task performance. This was confirmed through antecdotal reports by the teacher that once Susan was not engaging in stereotypic behavior during a peer's trial, the subsequent trial directed to her produced greater degrees of on-task behaviors. In addition, it was also observed that once Susan had omitted stereotypic responses during a peer's trial, she was likely to continue to omit stereotypic behaviors throughout her trial.

Both Carl and Susan produced significantly higher percentages of correct responses under DRO conditions. Theoretically, this increase in performance could be due to two factors. First, the students may have understood the multiple schedule aspect of the contingency. That is, that both correct responses and good waiting behavior were

necessary to achieve reinforcement. It is also possible that once a student brings herself on task (that is, once a student is not engaged in stereotypic responses), the student's attention can be better focused on the task.

An empirical question that remains to be answered is the comparative effectiveness of two models for the reduction of stereotypic responses. The models are: (a) the reduction in stereotypic responses causes an increase in task performance (eg. by allowing the student to focus attention on the task rather than the stereotypic behavior) so that the major focus in intervention should be the direct reduction in stereotypic behavior by applying consequences to the behavior itself, or (b) an increase in motivation for task performance causes decreases in stereotypic responding so that the major focus in intervention should be to manipulate task related variables. The present study is interesting in this regard because ultimately, the student needed to earn access to an instructional trial (by omitting stereotypic behavior during a peer's trial) as a condition for earning an instructional trial and then possibly earning reinforcement for task performance. During baseline, the students had essentially noncontingent access to instructional trials. Under those conditions, the students were under little pressure either to omit stereotypic reponses or to produce high frequencies of correct responses because the student only needed 10 tokens to gain access to the free time area. The rate of producing errors in those trials was not as directly exposed to consequences because students could remain in instruction

until sufficient tokens were earned regardless of the number of errors produced in achieving those 10 tokens. During the DRO phases, the students no longer had free access to instructional trials in that they had to omit producing stereotypic responses as a condition for receiving a trial. Hypothetically, the students may have shown increases in task performance because a correct performance was still needed to gain reinforcement, but trials themselves were more difficult to come by, thus the value of each trial to the student was increased. This analysis is consistent with recent findings (eg. Dunlap Dyer & Koegel, 1983; Weeks & Gaylord-Ross,1981) that point to the efficacy of manipulating task related variables (ie. variation in reinforcers, shorter inter-trial intervals, variation in tasks, and task difficulty.) to directly motivate increases in task performance and reduce stereotypic responding as a side effect.

In summary, the application of the DRO procedure was shown to functionally reduce the stereotypic responses displayed by the participants. The procedure was easier to implement than other applications of DRO because the time interval was defined according to the time it took for one peer trial to occur rather than an artifically determined length of time that would require attention to a timing device. The study was conducted under natural teaching conditions while students were being taught age-appropriate, functional skills. The study contributes a testable procedure to serve the growing demand for nonaversive behavior control

techniques that are usable under the natural constraints of classroom teaching.

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Table 1

Stereotypic Response Classes Targeted for Reduction

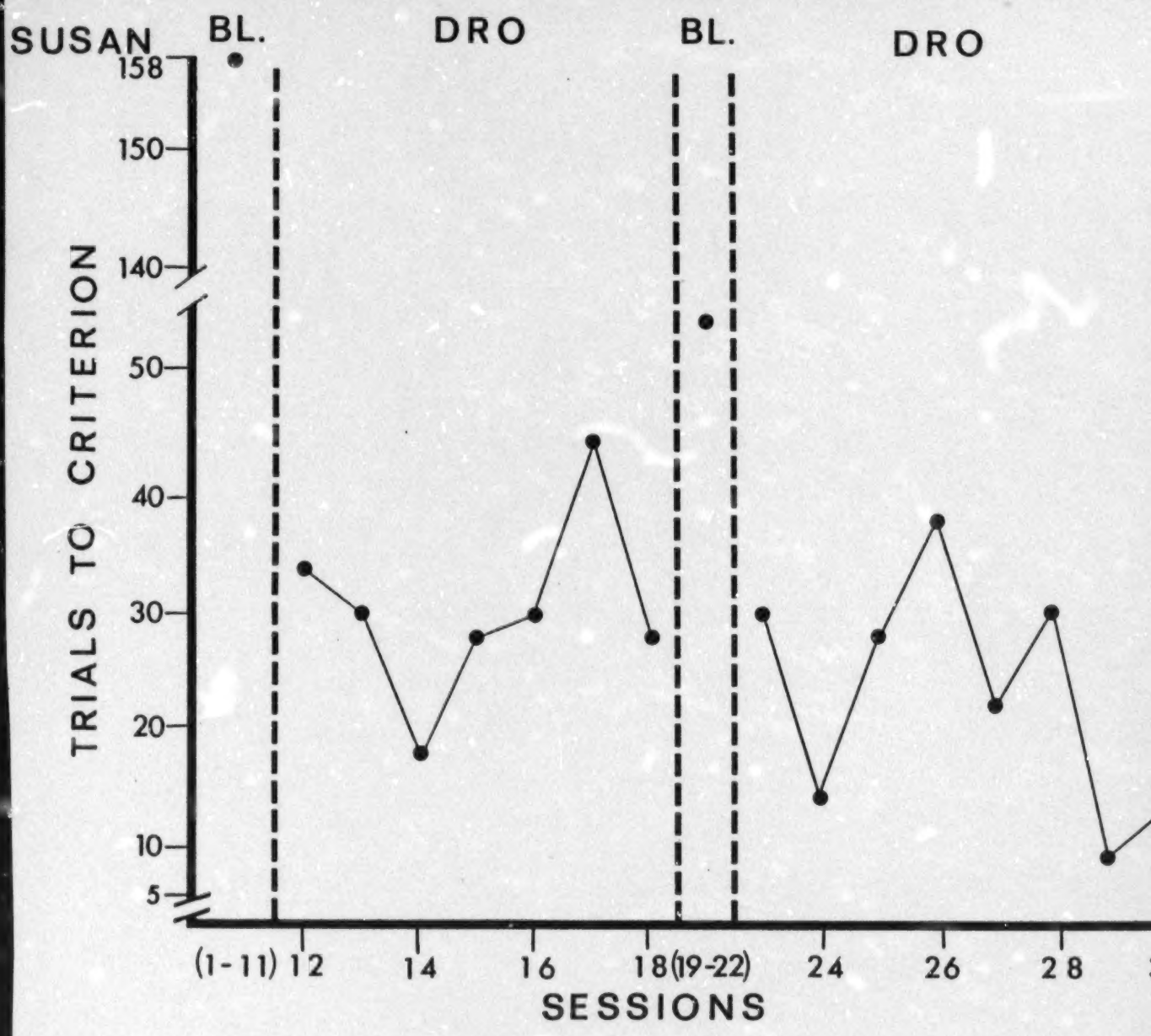
Participant	Response Class
Susan	Singing or speaking louder than a conversational level. Repetively slapping hands or objects onto table surface to produce noise.
Carl	Repeating phonemes (e.g. na-ga) in a sing-song fashion.
David	Non-task related vocalization.

Figure Captions

Figure 1. The number of trials required by Susan to reach criterion during baseline (BL.) and differential reinforcement of other behaviors (DRO). The data points for the first and second baseline phases were collected over 11 and 4 sessions respectively.

Figure 2. The number of trials required by David to reach criterion during baseline (BL.) and differential reinforcement of other behaviors (DRO). The data points for the first and second baseline phases were collected over 5 and 6 days respectively.

Figure 3. The number of trials required by Carl to reach criterion during baseline (BL.) and differential reinforcement of other behaviors (DRO). The data points for the first and second baseline phases were collected over 11 and 3 days respectively.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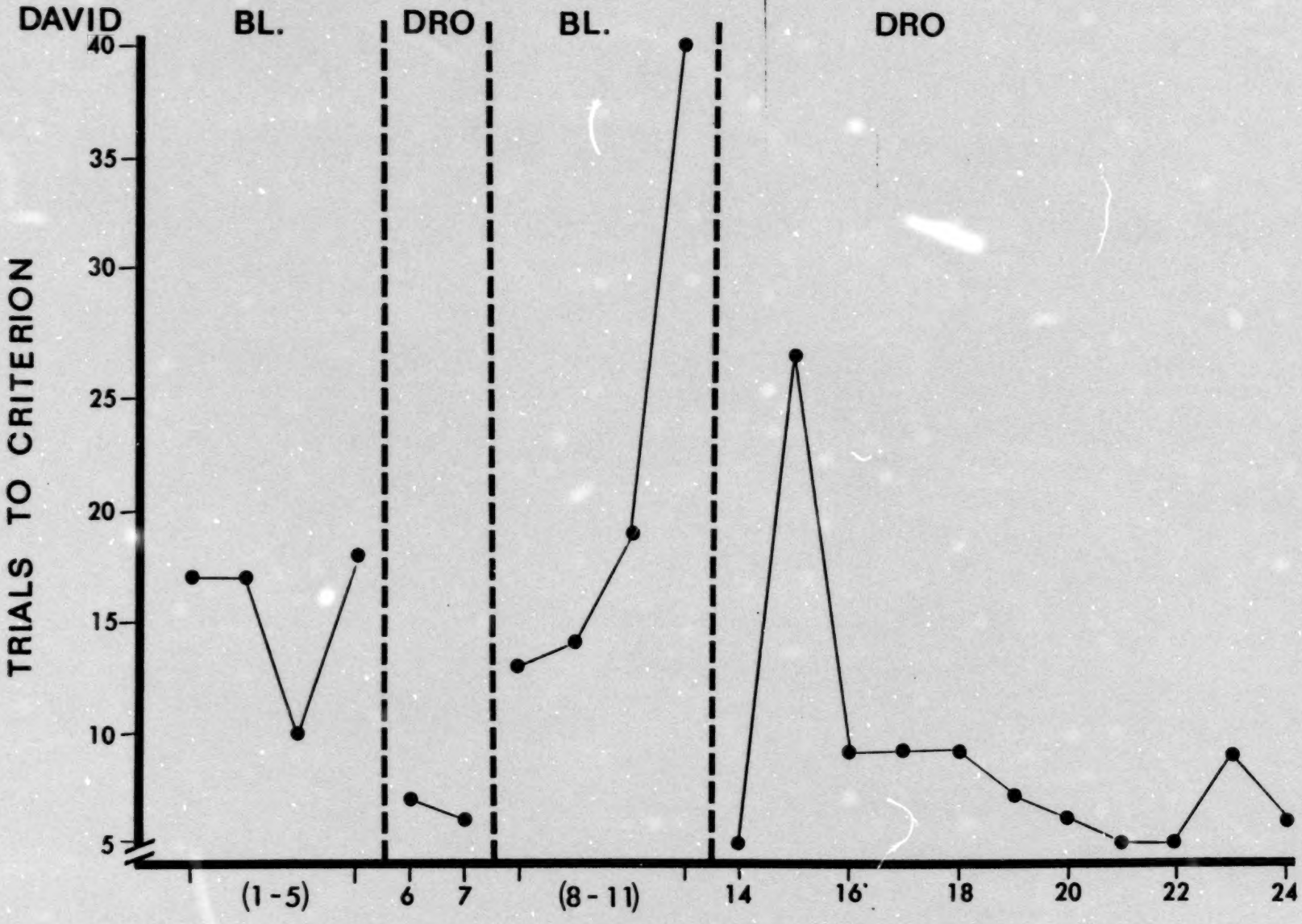
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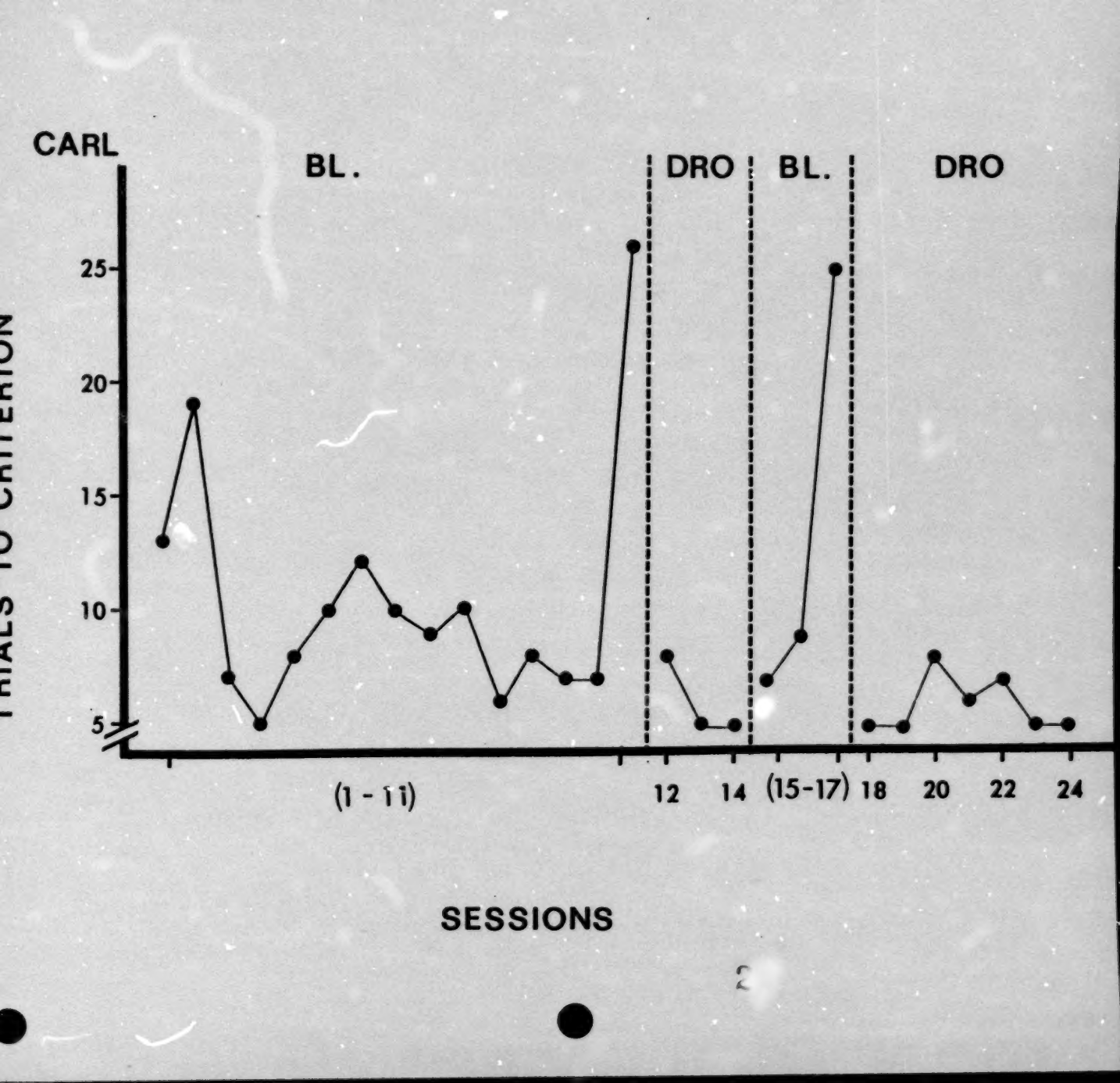
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